



Loxahatchee River Watershed Restoration Project Constraints



Water Quality
Water Supply
Flood Impact

May 9 , 2018





Water Quality Evaluation Tool



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- Evaluation tool approach:
 - ✓ Develop schematic diagram for ECB, FWO, and each alternative
 - ✓ Compile historical data (if available)* to estimate baseline flows, TP/TN concentrations, and TP/TN loads
 - ✓ Apply MODFLOW results to estimate flows, TP/TN concentrations, and TP/TN loads
 - ✓ Use conservative treatment assumptions for deep reservoirs, shallow impoundments, and natural storage features

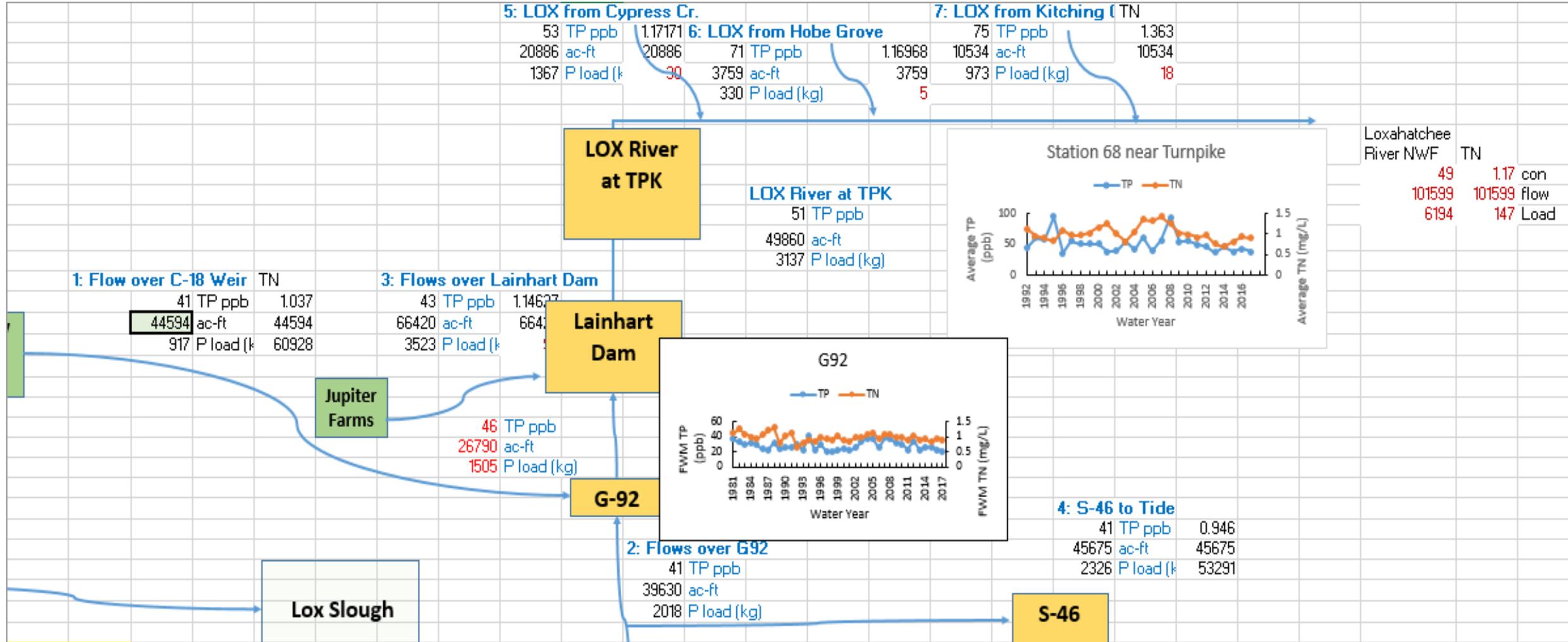
**Data sources include SFWMD's DBHYDRO database, FDEP, Loxahatchee River District, Indian Trail Improvement District, and Mock Roos*



Evaluation Tool – ECB Example



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Existing Conditions Example



- FWO WQ estimated to be similar to ECB WQ
 - Use MODFLOW outputs for FWO estimates
 - Calculate TP and TN concentrations for 3 flowways
 - Compare FWO with existing condition (ECB)

- FWO and ECB WQ used as starting point for alternatives evaluation
 - Use MODFLOW outputs of project features for all alternatives
 - Calculate TP and TN concentrations for 3 flowways
 - Compare concentrations with ECB, FWO and WQ standards.



WQ Improvement Assumptions



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- Total phosphorus treatment efficiencies conservatively estimated based on literature values, past Everglades performance, and best professional judgment:
 - Deep reservoirs assumed to have a concentration reduction of 15%
 - Shallow impoundments assumed to have a concentration reduction of 20%
 - Natural storage features assumed to have a 20% concentration reduction



Summary for TP Concentrations and Loads



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MODFLOW flow results used to calculate flow, loads, and TP

Site	ECB TP (ppb)	ECB Loads (kg)	FWO TP (ppb)	FWO Loads (kg)	Alt 2 TP (ppb)	Alt 2 Loads (kg)	Alt 5 TP (ppb)	Alt 5 Loads (kg)	Alt 10 TP (ppb)	Alt 10 Loads (kg)	Alt 13 TP (ppb)	Alt 13 Loads (kg)
CS3	92	6,428	92	6,430	92	6,494	76	6,415	35	1,764	92	6,502
C-18W	41	2,226	41	2,294	34	2,276	28	2,279	31	2,621	25	1,742
G-161	10	0	10	0	10	12	10	34	35	463	10	13
G-92	41	3,502	41	3,517	24	2,636	21	2,265	22	2,521	19	1,885
Lainhart	43	5,674	43	5,688	31	4,805	28	4,432	28	4,676	27	4,075
S-46	41	2,326	41	2,326	24	1,093	21	1,006	22	1,017	19	858
LR_NWF	50*	12,695	50*	12,709	41*	10,980	39*	10,607	39*	11,080	39*	10,142

*Target 54 ppb



Summary for TN Concentrations and Loads



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MODFLOW flow results used to calculate flow, loads, and TN concentrations (ppb) for ECB, FWO and 4 Alternatives:

Site	ECB TN (mg/L)	ECB Loads (tons)	FWO TN (mg/L)	FWO Loads (tons)	Alt 2 TN (mg/L)	Alt 2 Loads (tons)	Alt 5 TN (mg/L)	Alt 5 Loads (tons)	Alt 10 TN (mg/L)	Alt 10 Loads (tons)	Alt 13 TN (mg/L)	Alt 13 Loads (tons)
G-92	0.92	78	0.92	78	0.87	94	0.87	96	0.87	102	0.87	88
S-46	0.95	53	0.95	53	0.90	40	0.90	44	0.90	42	0.90	41
LR_NWF	1.17*	297	1.17*	297	1.11*	297	1.11*	299	1.12*	314	1.12*	289

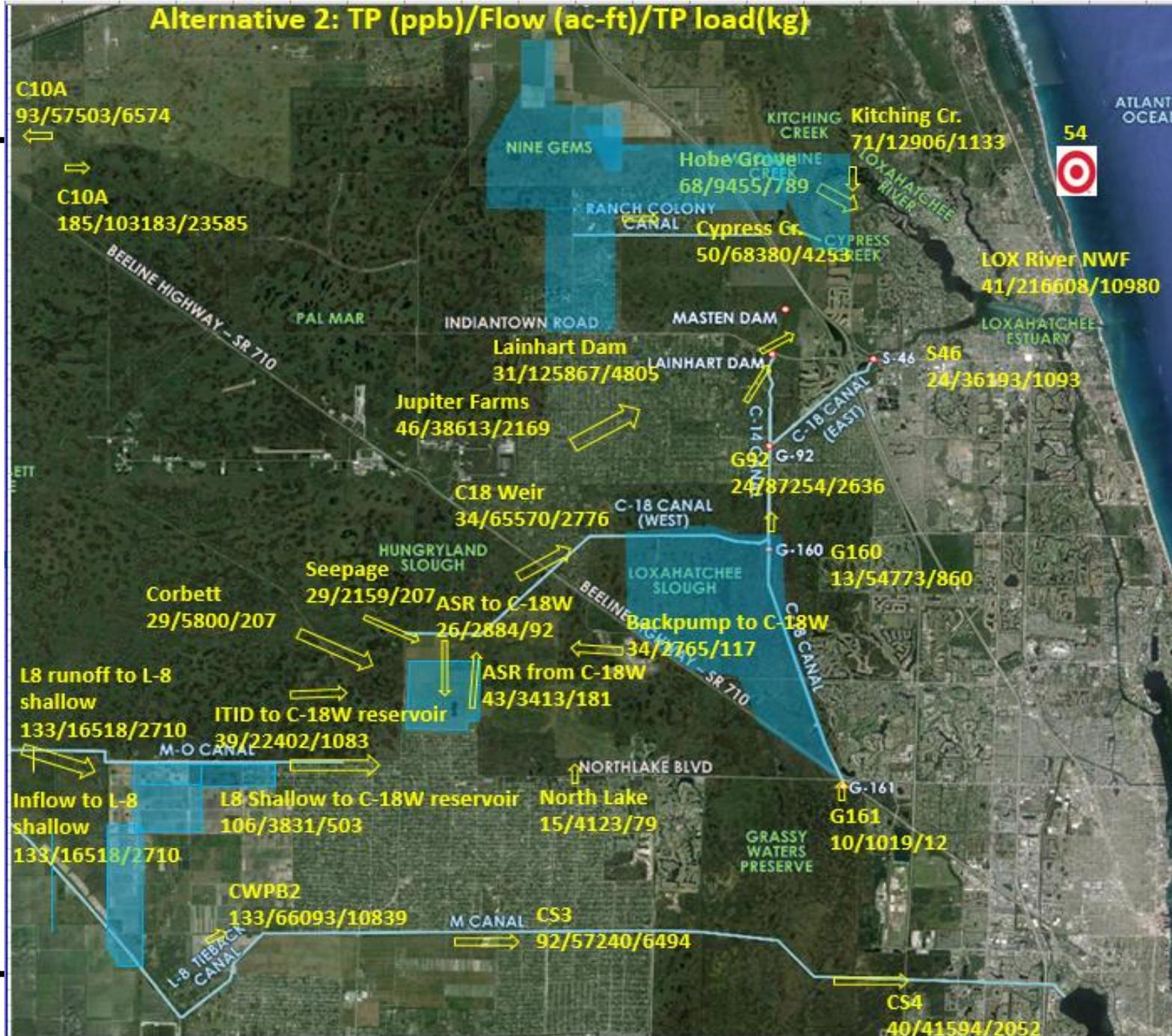
*Target 1.20 mg/L



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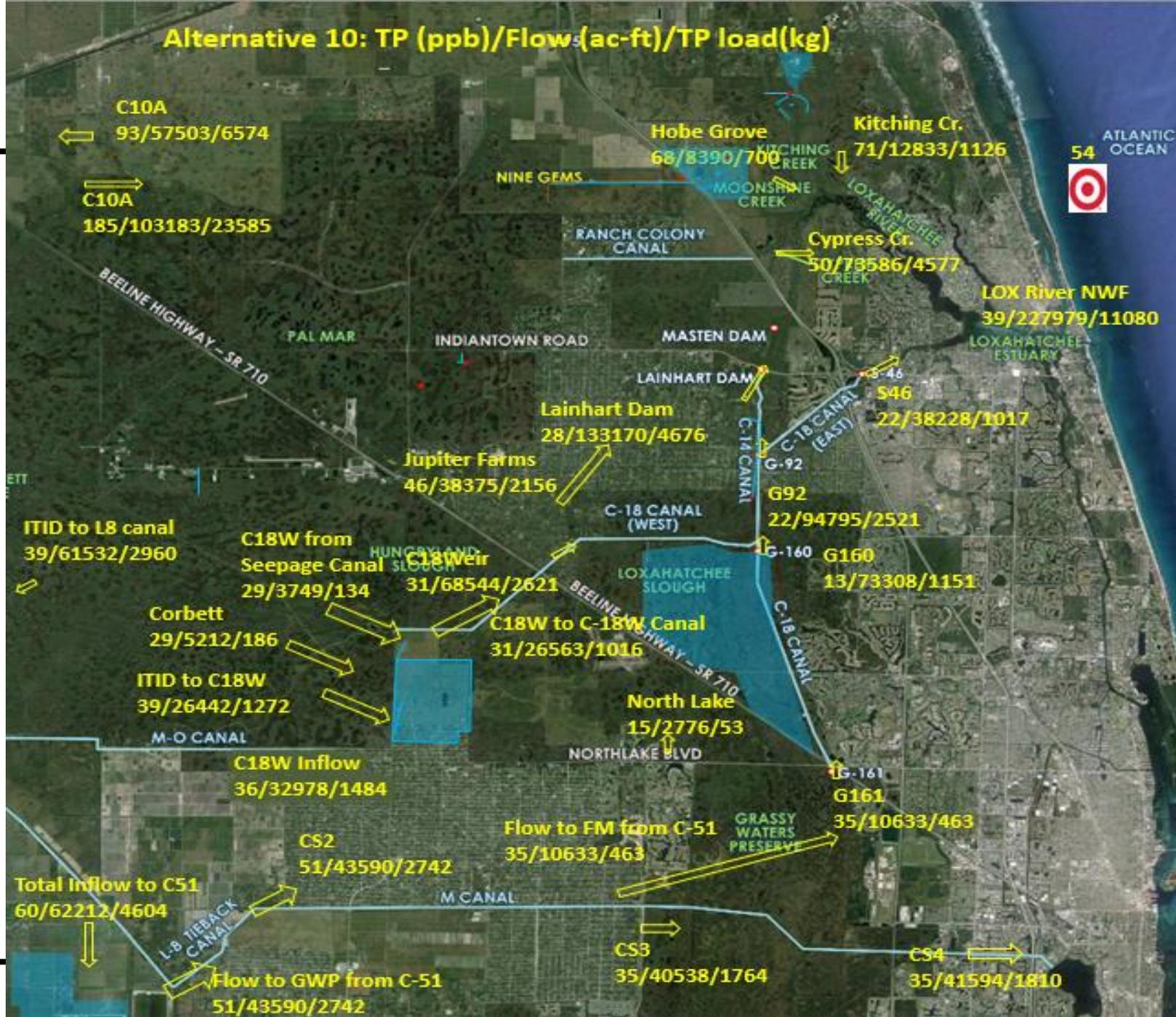


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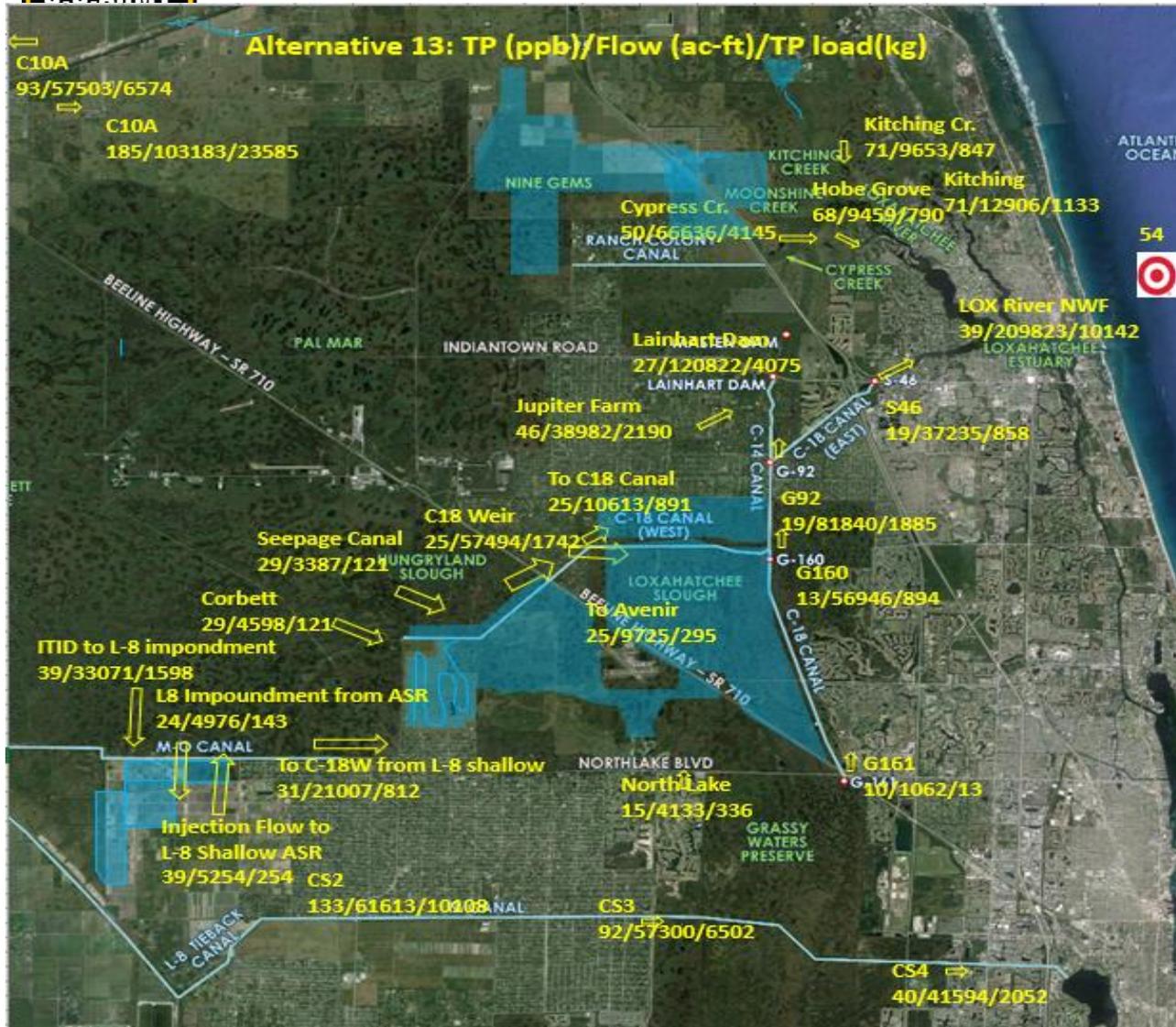
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Alternative 13



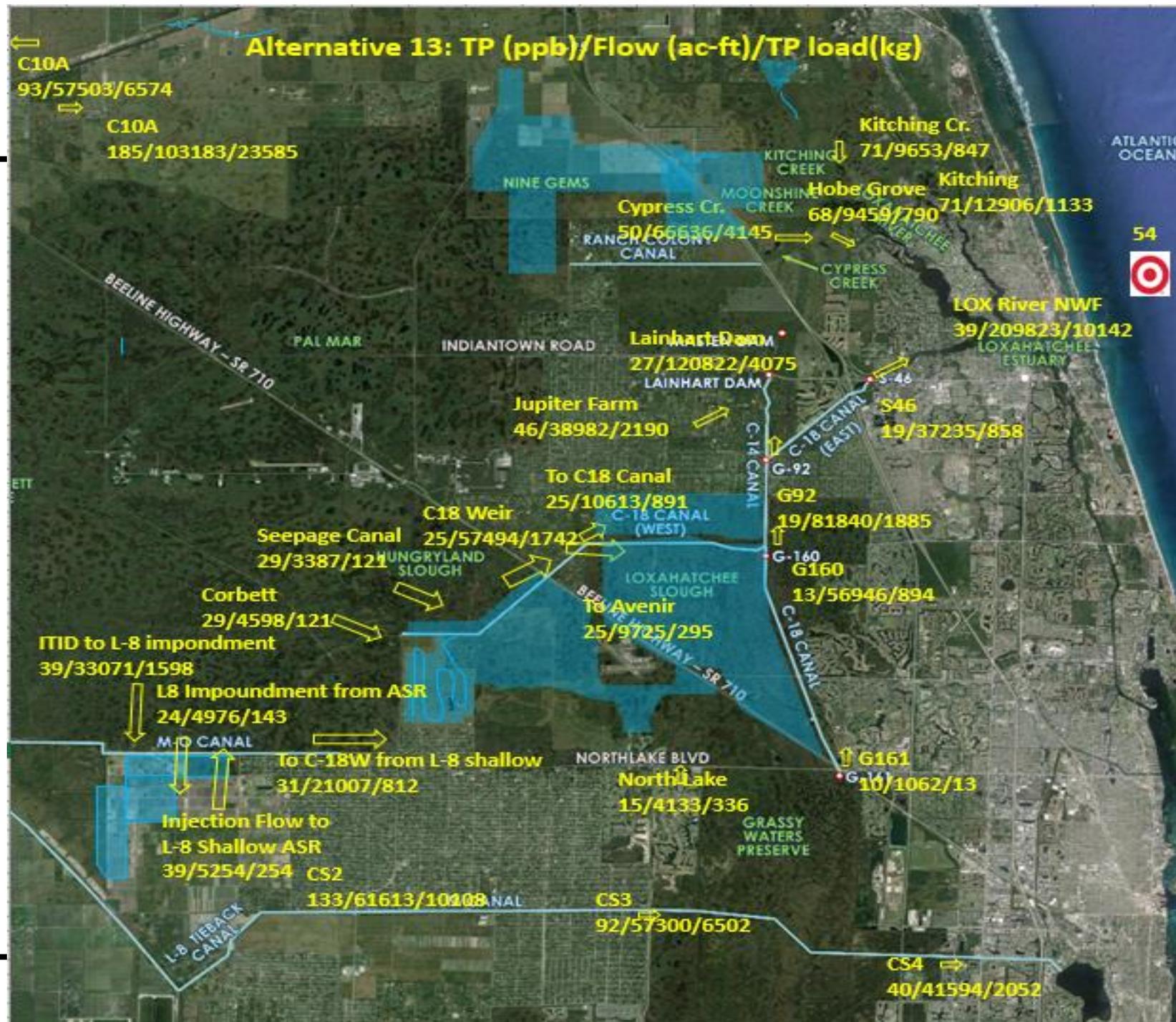
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Specific Conductance Analysis for Alt 10



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	Alt 10 Max	Alt 10 Expected	ECB
C-51 Area (acres)		1,600	-
C-51 Volume (ac-ft)		44,000	-
C-51 Depth (ft)		27.5	-
Seepage rate (in/day)	0.33 ¹	0.25 ²	
Annual seepage Qseep (ac-ft)	16,060	12,034	-
% of Seepage (Qseep/Qtotal)	26%	19%	-
Seepage Specific Conductance (μS/cm)	3,220 ³	3,220	-
Specific Conductance of C-51 Reservoir (μS/cm)	1,053	936	-
Specific Conductance of C-51 Reservoir at CS2 (μS/cm)	758 ⁴	709	548
Seepage Specific Conductance (μS/cm) for 800 (μS/cm) target at CS2	3,700	4,565	-

**Note: 1 - data in the dry season period of 4/28-6/17/2011 in L-8 reservoir extended to 365 day for maximum; 2 - extended 182 days of dry season and 183 days for half of the seepage rate for wet season; 3 - observation of L-8 FEB in 2016-2018. 4 - assumes mixing in L8 Canal*



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Historic Conditions Table



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Flowway	Basin/natural area	Inflow			Outflow		
		Volume (ac-ft)	TP (mg/L)	TN (mg/L)	Volume (ac-ft)	TP (mg/L)	TN (mg/L)
3	PalMar	Not measured	Not measured	Not measured	Not measured	Not measured	Not measured
3	Cypress Creek	Not measured	0.079	1.11	20,886	0.053	<1.54
3	Hobe-St.lucie	Not measured	0.110	1.26	3,759	0.071	<1.54
3	Kitching Creek	Not measured	0.079	1.32	10,534	0.075	1.363
2	C-18 Basin	27804	0.029	1.00	44594	0.017	0.98
2	C-18 Basin	16790	0.017	1.225	44594	0.029	1.037
2	Lox Slough	20639	0.015	1.011	34081	0.029	0.81
1	Lake Okeechobee C10A	103183	0.185	2.45			
1	L-8+Lake to C51	117925	0.143	2.3	117925	0.123	1.636
1	ITID	27804	0.039	1.352	27804	0.039	1.352
1	GWP	13442	0.01	0.839	2977 *	0.01	0.839
1	GWP	13442	0.01	0.839	17660 **	0.013	1.011
River	Loxahatchee River NWF	101599	0.049	1.17			
River	Middle Estuary (Southwest Fork)	45675	0.041	0.946			

NM = Not measured



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FWO Table



Flowway	Basin/natural area	Inflow			Outflow		
		Volume (ac-ft)	TP (mg/L)	TN (mg/L)	Volume (ac-ft)	TP (mg/L)	TN (mg/L)
3	PalMar	Not measured	Not measured	Not measured	Not measured	Not measured	Not measured
3	Cypress Creek	Not measured	0.079	1.11	73,167	0.053	<1.54
3	Hobe-St.lucie	Not measured	0.110	1.26	10,270	0.071	<1.54
3	Kitching Creek	Not measured	0.079	1.32	10,534	0.075	1.363
2	C-18 Basin	4777	0.017	1	45045	0.017	0.98
2	C-18 Basin	40268	0.043	1.104	45045	0.029	1.037
2	Lox Slough	4211	0.015	1.011	0	0.029	0.81
1	Lake Okeechobee C10A	103183	0.185	2.45			
1	L-8+Lake	101003	0.123	2.3	-85811	0.000	0.000
1	ITID	85811	0.039	1.352	85811	0.039	1.352
1	GWP	56684	0.01	0.839	2977 *	0.01	0.839
1	GWP	56684	0.01	0.839	17660 **	0.013	1.011
River	Loxahatchee River NWF	205531	0.050	1.17			
River	Middle Estuary (Southwest Fork)	36311	0.041	0.946			

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Alternative 2 Table

Flowway	Basin/natural area	Inflow			Outflow			Data Sources
		Volume (ac-ft)	TP (mg/L)	TN (mg/L)	Volume (ac-ft)	TP (mg/L)	TN (mg/L)	
3	PalMar	Not measured	Not measured	Not measured	Not measured	Not measured	Not measured	Not applicable
3	Cypress Creek	Not measured	0.079	1.11	68,380	0.050	<1.54	LRD 2016
3	Hobe-St.lucie	Not measured	0.110	1.26	9,455	0.071	<1.54	LRD 2016
3	Kitching Creek	Not measured	0.079	1.32	12,906	0.068	1.363	LRD 2016
2	C-18 Basin	5800	0.017	1	44594	0.034	0.985	LRD 2016
2	C-18 Basin	16790	0.017	1.225	65570	0.034	0.985	SFWMD, DBHYDRO, 2017
2	Lox Slough	13814	0.011	1.011	54773	0.013	0.81	Mock Roos 2017
1	Lake Okeechobee C10A	0	0.000	2.45				
1	L-8+Lake	129211	0.185	2.3	129211	0.123	1.636	Julian 2016
1	ITID	16518	0.039	1.352	16518	0.039	1.352	IDIT personal communication, and SFWMD, DBHYDRO, 2017
1	GWP	57240	0.01	0.839	2977 *	0.01	0.839	SFWMD, DBHYDRO, 2017
1	GWP	57240	0.01	0.839	17660 **	0.013	1.011	SFWMD, DBHYDRO, 2017
River	Loxahatchee River NWF	216608	0.041	1.11				Julian 2016
River	Middle Estuary (Southwest Fork)	36193	0.024	0.899				LRD 2016

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Alternative 5 Table

Flowway	Basin/natural area	Inflow			Outflow		
		Volume (ac-ft)	TP (mg/L)	TN (mg/L)	Volume (ac-ft)	TP (mg/L)	TN (mg/L)
3	PalMar	Not measured	Not measured	Not measured	Not measured	Not measured	Not measured
3	Cypress Creek	Not measured	0.050	1.11	68,380	0.050	<1.54
3	Hobe-St.lucie	Not measured	0.110	1.26	9,455	0.068	<1.54
3	Kitching Creek	Not measured	0.079	1.32	12,900	0.071	1.363
2	C-18 Basin	6214	0.029	1	66888	0.028	0.985
2	C-18 Basin	2988	0.029	1.225	66888	0.028	0.985
2	Lox Slough	9634	0.014	1.011	59334	0.013	0.81
1	Lake Okeechobee C10A	103183	0.185	2.45			
1	L-8+Lake	203864	0.133	2.3	203864	0.123	1.636
1	ITID	27639	0.039	1.352	27639	0.039	1.352
1	GWP	68134	0.01	0.839	9872	0.01	0.839
1	GWP	68134	0.01	0.839	6834	0.02	1.011
River	Loxahatchee River NWF	218363	0.039	1.110			
River	Middle Estuary (Southwest Fork)	39561	0.021	0.899			

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Alternative 10 Table



Flowway	Basin/natural area	Inflow			Outflow		
		Volume (ac-ft)	TP (mg/L)	TN (mg/L)	Volume (ac-ft)	TP (mg/L)	TN (mg/L)
3	PalMar	Not measured	Not measured	Not measured	Not measured	Not measured	Not measured
3	Cypress Creek	Not measured	0.079	1.11	73,586	0.050	<1.54
3	Hobe-St. Lucie	Not measured	0.110	1.26	8,390	0.068	<1.54
3	Kitching Creek	Not measured	0.079	1.32	12,833	0.071	1.363
2	C-18 Basin	5212	0.017	1	68544	0.031	0.985
2	C-18 Basin	0	0.000	1.225	68544	0.031	0.985
2	Lox Slough	13409	0.031	1.011	73308	0.013	0.81
1	Lake Okeechobee C10A	103183	0.185	2.45			
1	L-8+Lake	0	0.000	2.3	43590	0.123	1.636
1	ITID	87974	0.039	1.352	87974	0.039	1.352
1	GWP	40538	0.01	0.839	10633	0.01	0.839
1	GWP	40538	0.01	0.839	2776	0.0154385	1.011
River	Loxahatchee River NWF	227979	0.039	1.12			
River	Middle Estuary (Southwest Fork)	38228	0.022	0.899			



Alternative 13 Table



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Flowway	Basin/natural area	Inflow			Outflow		
		Volume (ac-ft)	TP (mg/L)	TN (mg/L)	Volume (ac-ft)	TP (mg/L)	TN (mg/L)
3	PalMar	Not measured	Not measured	Not measured	Not measured	Not measured	Not measured
3	Cypress Creek	Not measured	0.079	1.11	66,636	0.050	<1.54
3	Hobe-St.Lucie	Not measured	0.110	1.26	9,459	0.071	<1.54
3	Kitching Creek	Not measured	0.079	1.32	12,906	0.071	1.363
2	C-18 Basin	4598	0.029	1	57494	0.025	0.985
2	C-18 Basin	0	0.000	1.225	10613	0.025	0.985
2	Lox Slough	10787	0.023	1.011	56946	0.013	0.81
1	Lake Okeechobee	0	0.000	2.45			
1	L-8+Lake	0	0.000	2.3	61613	0.031	1.636
1	ITID	33071	0.039	1.352	33071	0.039	1.352
1	GWP	57300	0.01	0.839	9862	0.010	0.839
1	GWP	57300	0.01	0.839	4133	0.015	1.011
River	Loxahatchee River NWF	209823	0.039	1.116			
River	Middle Estuary (Southwest Fork)	37235	0.019	0.8987			

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